A close look at melting below Antarctica's largest ice shelf

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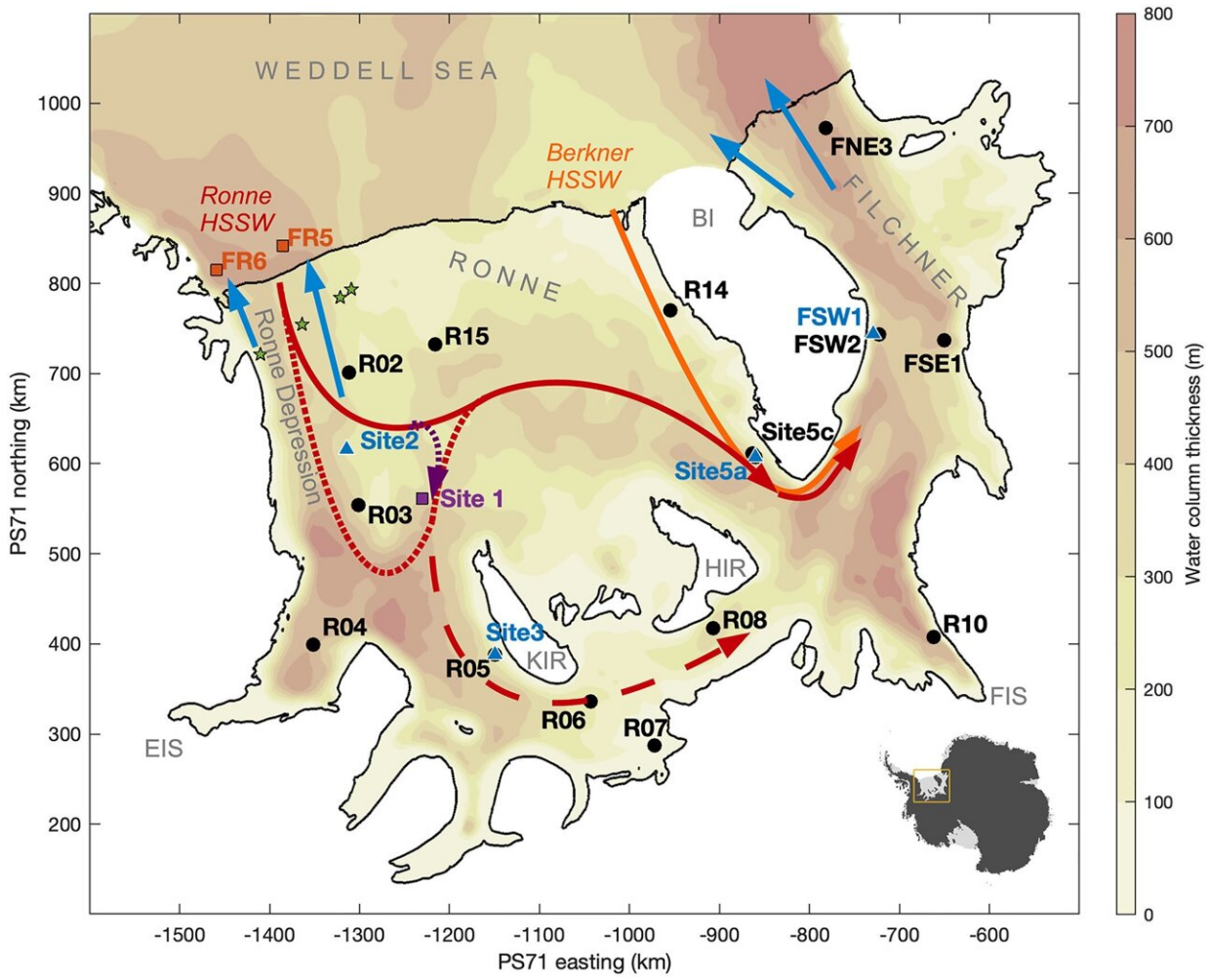

Map of the Filchner-Ronne Ice Shelf using the polar stereographic projection (PS71), inset shows study area location in Antarctica. The contours mark water column thickness in 100-m intervals, the colormap being saturated at 800 m. The deployment sites include ApRES (black dots), sub-ice shelf moorings (blue

triangles for time series shown here, green stars for mooring array, and purple square for Site 1), and ocean moorings (red squares). Geographic labels are as follows: EIS = Evans Ice Stream, FIS = Foundation Ice Stream, KIR = Korff Ice Rise, HIR = Henry Ice Rise, BI = Berkner Island. Flow pathways are shown schematically. Ronne and Berkner High-Salinity Shelf Water (HSSW) inflows are in red and orange, respectively. Blue arrows mark known Ice-Shelf Water outflows. Our results show that the inter-annual variability in the Ronne HSSW volume propagates across the center of the Ronne Ice Shelf (the solid and possibly also the dotted line), but the signal doesn't reach the back of the cavity behind KIR and HIR (the dashed line). Dotted purple line indicates a plausible inter-annual alternative of faster flow toward R05. Credit: *Journal of Geophysical Research: Oceans* (2022). DOI: 10.1029/2022JC018879

The Antarctic Ice Sheet is the largest block of ice in the world. It covers an area four times the size of China and holds more than 60% of the world's fresh water. Where the ice sheet meets the ocean, it forms floating shelves that cool and freshen the salty waters below as they melt. Because of the Antarctic Ice Sheet's vast size and effects on the ocean, the rates at which its shelves melt play key roles in influencing Earth's climate.

In a new study, Vaňková and Nicholls used 14 ground-based radars to monitor the rate at which the base of the Filchner-Ronne Ice Shelf (FRIS)—the continent's largest by ice volume, located in West Antarctica—has been melting both seasonally and annually.

The radars collected measurements at least every two hours, with the shortest-running device active for several months and the longest-running one active for six years. At two of the sites, the team used ocean mooring data to extrapolate further back in time, obtaining up to 15-year-long melt rate time series, by far the longest such measurement in Antarctica.

The researchers found that the highest melt rates follow episodes of low summer sea ice concentrations outside the ice shelf. They also showed that the strength of this melt rate signal is spatially nonuniform across the ice shelf. In comparing the radar time series with satellite data, they found similar average melt rates using both methods.

However, the radar data show that melting below broad areas of FRIS varies to a much lower extent than indicated by the existing satellite estimates. In addition, they note, the time series can help scientists determine whether ocean models are accurately predicting melt rate changes and which regions need further ground-based data collection, according to the researchers.

More accurate melt rate measurements offer a better understanding of dynamical interactions between the ocean and the Antarctic Ice Sheet. Understanding ongoing changes and improved capability to reproduce those changes in Earth system models can, in turn, lead to better constraints on sea level rise projections and other climate change impacts, according to the authors.

The research was published in *Journal of Geophysical Research: Oceans*.

More information: Irena Vaňková et al, Ocean Variability Beneath the Filchner-Ronne Ice Shelf Inferred From Basal Melt Rate Time Series, *Journal of Geophysical Research: Oceans* (2022). DOI: 10.1029/2022JC018879